

# Audit



# Report

OFFICE OF THE INSPECTOR GENERAL

ACQUISITION OF THE  
ADVANCED FIELD ARTILLERY SYSTEM

Report No. 94-111

May 25, 1994

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### **Acronyms**

AFAS	Advanced Field Artillery System
ASM	Armored Systems Modernization
COEA	Cost and Operational Effectiveness Analysis
GAO	General Accounting Office
HMMWV	High Mobility Multipurpose Wheeled Vehicle
mm	millimeter
RDT&E	Research, Development, Test, and Evaluation



**INSPECTOR GENERAL  
DEPARTMENT OF DEFENSE  
400 ARMY NAVY DRIVE  
ARLINGTON, VIRGINIA 22202-2884**

May 25, 1994

**MEMORANDUM FOR AUDITOR GENERAL, DEPARTMENT OF THE ARMY**

**SUBJECT: Audit Report on the Acquisition of the Advanced Field Artillery System  
(Report No. 94-111)**

We are providing this report for your review and comments. The audit was one of our continuing audits of major acquisition programs. This report discusses issues concerning the force effectiveness and affordability of the Advanced Field Artillery System and other systems and the cost and operational effectiveness analyses for the Advanced Field Artillery System. Comments on a draft of this report were considered in preparing the final report.

DoD Directive 7650.3 requires that all recommendations be resolved promptly. Therefore, we request that the Army's Vice Chief of Staff and the Director for Assessment and Evaluation in the Office of the Assistant Secretary of the Army (Research, Development and Acquisition) provide comments on the unresolved recommendations by July 25, 1994. We did not claim potential monetary benefits in this report since they are undeterminable until management makes certain decisions as explained in Appendix C.

We appreciate the courtesies extended to the audit staff. The audit team members are listed inside the back cover. If you have questions on this audit, please contact Mr. Rayburn H. Stricklin, Program Director, at (703) 614-3965 (DSN 224-3965) or Mr. Robert L. Shaffer, Project Manager, at (703) 614-1416 (DSN 224-1416). Appendix E lists the distribution of this report.

*David K. Steensma*

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Deputy Assistant Inspector General  
for Auditing

## Office of the Inspector General, DoD

Report No. 94-111  
(Project No. 3AL-0025)

May 25, 1994

### ACQUISITION OF THE ADVANCED FIELD ARTILLERY SYSTEM

#### EXECUTIVE SUMMARY

**Introduction.** The Advanced Field Artillery System (AFAS) is a 155-millimeter self-propelled howitzer designed for the battlefield environment of the next century. This system is to offer a notable increase in mobility, survivability, and lethality over the M109A6 (Paladin), the present system. The AFAS is to provide close, tactical, and operational fire support during offensive and defensive operations. On September 16, 1992, the AFAS was designated a Milestone 0, Concept Exploration/Definition Program. The AFAS Project Management Office, located at Picatinny Arsenal, Dover, New Jersey, manages the AFAS Program under the direction of the Program Executive Officer for Armored Systems Modernization.

**Objectives.** The audit objective was to evaluate the acquisition management of the AFAS Program regarding program management elements critical for a system in the Concept Exploration/Definition phase of the acquisition cycle. We also evaluated the adequacy of internal controls related to the program management elements.

**Audit Results.** Our audit disclosed two conditions warranting management action.

- o The Army was continuing the development of the Advanced Field Artillery System and eight other major systems, which were estimated to cost \$71.4 billion, despite its own interactive multi-system analyses that questioned the systems' contributions to total force effectiveness and affordability. As a result, the Army could incur substantial costs for systems that may not add significantly to total force effectiveness at projected funding levels (Finding A).

- o The scope of the Cost and Operational Analysis (COEA) for the AFAS Program was limited. As a result, the COEA that was being developed for the AFAS will not provide the Defense Acquisition Board the information necessary to determine whether the AFAS is the most cost and operationally effective solution to DoD's deficiencies in its artillery systems (Finding B).

**Internal Controls.** The audit did not identify internal control weaknesses. Our review of internal controls is in Part I.

**Potential Benefits of the Audit.** The audit did not identify quantifiable monetary benefits. However, recommendations in Findings A and B could result in monetary benefits, depending on management's actions. We asked that management inform us of any monetary benefits stemming from adopting the recommendations. Other potential benefits of the audit include improving the processes for determining total force effectiveness and affordability of the Army's systems, as well as determining the cost and operational effectiveness of the AFAS. Appendix C summarizes the potential benefits of the audit.

**Summary of Recommendations.** We recommended that management improve the processes for determining the force effectiveness and affordability of the Army's systems and determining the cost and operational effectiveness of the AFAS.

**Management Comments.** The Army's Vice Chief of Staff did not provide comments on the two recommendations addressed to him. The Army's Acting Assistant Secretary (Research, Development and Acquisition) nonconcurred with all recommendations. The Acting Assistant Secretary stated that the Army used the Value-Added Analysis as a tool to gain insights to support prioritization and resource allocation decisions. The Acting Assistant Secretary also stated that the Army had included three alternatives in the Cost and Operational Effectiveness Analysis that those alternatives were appropriate for a Milestone I decision.

**Audit Response.** After evaluating management comments, we remain convinced that our recommendations are still valid. Our reasons are provided in Part II of the report along with requests for Army officials to reconsider their positions and to comment again on the recommendations when responding to this report. We asked the officials to provide their comments by July 25, 1994.

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This report was prepared by the Acquisition Management Directorate, Office of the Assistant Inspector General for Auditing, Department of Defense.

## **Part I - Introduction**

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## Background

The Advanced Field Artillery System (AFAS) is to be the Army's technologically advanced 155-millimeter (mm) howitzer, providing indirect fire support for the maneuver force. Originally, the AFAS was one of six systems to be developed under the Armored Systems Modernization (ASM) - Future Program. The Block III tank was the lead system for the ASM Program. The Block III Tank Program attained Milestone I approval in late FY 1990. The ASM Program was restructured in FY 1991 in response to the changing threat and as a result of congressional direction. The AFAS and the Future Armored Resupply Vehicle, which is to resupply the AFAS with ammunition and propellant, became the lead systems in the ASM Program. A Conventional Systems Committee's review, conducted on August 27, 1992, confirmed that Milestone 0 requirements for the AFAS had been satisfactorily met. The Milestone I decision review was scheduled for the fourth quarter of FY 1994.

The AFAS is intended to provide the Army with a successor to the Paladin 155-mm self-propelled howitzer. A key feature planned for the AFAS is a new regenerative liquid propellant gun that will enable the AFAS to meet extended range (40 to 50 kilometers) and increased rate-of-fire (10-12 rounds per minute) and to conduct multiple-round simultaneous-impact missions. The AFAS will include an automatic ammunition handling system, allowing the crew to remain in the vehicle and to be separated from the weapon station during firing. In total, the Army plans to spend about \$3.2 billion of research, development, test, and evaluation (RDT&E) funds on the AFAS.

The Under Secretary of Defense for Acquisition and Technology prescribes overall policy for procurement of major weapon systems in the DoD. The Defense Acquisition Board has responsibility for deciding at the Milestone I review whether the degree of concept exploration and definition warrants approval to move the AFAS to the next acquisition phase. Within the Army, the Assistant Secretary of the Army (Research, Development and Acquisition) is responsible for program oversight.

## Objectives

Our audit objective was to evaluate the effectiveness of the acquisition management of the AFAS to determine whether program officials were adequately evaluating alternative solutions to Defense deficiencies, identifying and quantifying risk factors, and preparing for the demonstration and validation phase of the system's development. We performed the audit in accordance with our critical program management elements approach. Under that approach, we focused our audit on reviews of eight program management elements that were critical to the AFAS Program in its preparation for the demonstration and validation phase of the acquisition cycle. We also evaluated the adequacy of internal controls related to those management elements.



Our reviews of concept impacts and alternative design analysis resulted in two findings that are in Part II of this report. The results of our reviews of requirements and budgeting are discussed in Appendix A, "Other Items Warranting Management's Attention." Our review disclosed no problems in the areas of scheduling or contracting. It was too early in the AFAS Program to effectively evaluate the areas of cost estimating and analysis and test planning. These four program management elements are discussed in Appendix B.

## Scope and Methodology

We conducted this economy and efficiency audit from January 1993 through November 1993. We reviewed records and supporting documentation dated from 1981 through September 1993. In doing so, we evaluated test plans and schedules, performance and quantitative requirements of the AFAS and its mission, system concepts, studies of alternatives, contractual actions, budget and cost estimates, and internal control assessments relating to the AFAS Program.

Additionally, we used computer-processed data in reaching the conclusions on the Value-Added Analysis (VAA) addressed in Finding A. We did not test the reliability of the data base that the Army's Concepts Analysis Agency (CAA) used for the VAA for various reasons. First, the VAA that we used in the audit was the second such analysis conducted by the CAA. Therefore, the methodology for the VAA was proven. Second, the conclusions stemming from the VAA were well accepted by the Army's officials. Last, our assessment of the methodology used for the VAA, as well as our efforts to validate the cost estimates that the CAA used in the VAA, disclosed no significant flaws in the methodology or the cost estimates. However, since we did not test the reliability of the data base used to conduct the VAA, we are unable to provide projections or conclusions on the accuracy of the data base.

Except as noted above on our use of conclusions stemming from the VAA, the audit was made in accordance with auditing standards issued by the Comptroller General of the United States, as implemented by the Inspector General, Department of Defense, and accordingly included such tests of internal controls as considered necessary. Appendix D lists the organizations that we visited or contacted during the audit.

## Internal Controls

We evaluated the internal controls applicable to the eight critical program management elements of the AFAS Program. In assessing the internal controls, we evaluated internal control techniques, such as management plans and procedures, vulnerability assessments, written policies and procedures, and

## Introduction

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management-initiated reviews. No material internal control deficiencies were identified as defined by DoD Directive 5010.38, "Internal Management Control Program, " April 14, 1987.

## Prior Audits

The General Accounting Office (GAO) initiated an audit of the Army's revised ASM Program in August 1993. The objectives of the audit were to evaluate several aspects of the AFAS, including performance requirements, cost estimates, concept analyses, budget constraints, and prior ASM components.

**General Accounting Office Report No. GAO/NSIAD-93-49 (OSD Case No. 9096), "Antiarmor Weapons Acquisitions: Assessments Needed To Support Continued Need and Long Term Affordability," March 4, 1993.** The report stated that the DoD had not conducted sufficient analyses of its antiarmor needs and alternative capabilities to meet mission requirements. The report also stated that the Military Departments justified their current acquisitions on the need to defeat the previous threat: the Soviet and Warsaw Pact. Finally, the report stated that the Military Departments had not assessed the affordability of major acquisitions through the end of procurement.

The GAO recommended that the Secretary of Defense:

- o Assess the continued need for currently planned antiarmor acquisitions in light of the changed threat.
- o Ensure that the Military Departments are not acquiring systems that unnecessarily duplicate existing capabilities because they did not fully consider alternative materiel or mission solutions.
- o Require the Military Departments to assess long-term affordability of antiarmor acquisitions as required by the DoD 5000 series regulations.

The GAO did not receive from the DoD written comments on the recommendations. However, the GAO discussed a draft of the audit report with responsible officials in the DoD. The officials generally agreed with the GAO's findings and recommendations.

We are making recommendations in this report that are somewhat similar to the GAO's recommendations.

**General Accounting Office Report No. GAO/NSIAD-92-180 (OSD Case No. 9003), "Major Acquisitions: DoD's Process Does Not Ensure Proper Weapons Mix for Close Support Mission," April 17, 1992.** The report stated that the DoD did not develop and procure the proper mix of close support weapons to meet current and planned mission requirements. The GAO recommended that the Secretary of Defense strengthen the DoD's analysis of close support mission needs to ensure that each requirement and acquisition

decision is made only after full disclosure and evaluation of the expected contribution of all complementary close support weapon systems. The Under Secretary of Defense for Acquisition (renamed Under Secretary of Defense for Acquisition and Technology in November 1993) agreed that sufficient analysis should ensure weapon systems are developed to meet mission requirements most effectively. However, the Under Secretary maintained that the acquisition process in place provided assurance that the DoD develops and procures weapons that meet mission needs.

The results of our audit indicate that the Under Secretary may not be totally correct. In Finding A of this report, we address a report on an Army study that questioned the contributions that several major acquisition programs will make to the Army's total force.

In 1993, the Army Audit Agency, at the request of the Deputy Assistant Secretary of the Army (Procurement), reviewed contracts that the Army awarded for research and development in 1992. The Deputy Assistant Secretary wanted to know whether the basic precepts of the acquisition process were being applied by individuals who develop, influence, review, and approve acquisition strategies and plans. In satisfying that request, the Army Audit Agency reviewed eight contracts for research and development of the AFAS. The Army Audit Agency did not find any systemic problems in its review of the contracts and discontinued the audit without preparing an audit report.

## Other Matters of Interest

This audit also identified several matters of interest that warranted management's attention but did not warrant audit recommendations. The matters involved the validity of performance and quantitative requirements for the AFAS, the consideration of cooperative development efforts with other countries, the use of a foreign system as a possible alternate solution to the Army's deficiencies in field artillery, the reasonableness of budget estimates for the AFAS Program, and the competitiveness of the acquisition strategy for the AFAS Program. Those matters are discussed further in Appendix A.

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## **Part II - Findings and Recommendations**

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## **Finding A. Value-Added Analysis**

The Army continued to develop the Advanced Field Artillery System and eight other major systems, which were estimated to cost \$71.4 billion, despite an interactive analysis of multiple systems that questioned the systems' contributions to total force effectiveness and affordability at projected funding levels. The Army did not act on the June 1992 Value-Added Analysis because its officials considered the analysis to be only one of many tools that they used to make budget decisions. As a result, the Army could incur substantial costs for systems that may not add significantly to total force effectiveness and may not be affordable at projected funding levels.

### **Background**

The DoD Instruction 5000.2, Part 4, Section E, and the DoD 5000.2-M, Part 8, require that the DoD Components consider all reasonable options to a new major system and that such considerations include force structure attributes, where appropriate. The DoD 5000.2-M adds that force structure considerations include a mix of ground and air-delivered ordnance in the evaluations of alternatives.

The Army's Director for Program Analyses and Evaluation, Office of the Chief of Staff, conceived the need for a Value-Added Analysis as a means of conducting program trade-off analyses. In early 1989, the Director asked the Technical Advisor in the Office of the Army's Deputy Chief of Staff for Operations and Plans to join him in sponsoring a Value-Added Analysis to be conducted by the Army's Concepts Analysis Agency. The analysis was performed in a phased approach. Phase I was called the "Army Program Value-Added Analysis 90-97." The primary purpose of the analysis was to develop and demonstrate a methodology for conducting marginal cost benefit analyses.

The resulting Value-Added Analysis provided important insights into the use of aggregated effectiveness models, new costing approaches, and optimization techniques. The Value-Added Analysis also successfully assigned weights for subjective elements used by decisionmakers in conducting tradeoffs between alternatives. In May 1991, upon completion of Phase I of the analysis, the Army's Concepts Analysis Agency initiated Phase II to implement the methodology, as created and defined in the Phase I work. The objectives of the analysis were to produce value-added coefficients and feasible acquisition alternatives, constrained by the Army's total obligation authority for modernization. An essential element of the Value-Added Analysis was to determine the value added of major Army systems in Research and Development to be considered in the FYs 1994 through 1999 Program Objective Memorandum.

## Value-Added Analysis

In the Phase II analysis, the Concepts Analysis Agency measured the effectiveness of 41 systems, using a five-step process. First, the Concepts Analysis Agency used an explicit effectiveness model, portraying the systems in combat simulations, to measure each of the 41 systems' contributions to combat effectiveness and force-level performance. The force mixes were evaluated in both stressful and contingency scenarios. The stressful scenario was a maximum effort battle, specifically a massive Soviet invasion of Western Europe. The contingency scenario was a regional conflict similar to Operation Desert Storm. The explicit effectiveness model calculated a Fractional Exchange Ratio, which determined the percentage of enemy losses during simulated battles as compared to friendly losses, to determine the effectiveness of each of the 41 systems against the enemy. Also, the model determined the percentage of friendly forces remaining after the simulated battle.

Second, the Concepts Analysis Agency realized that procurement decisions were based on more than explicit effectiveness measurements. As such, the Concepts Analysis Agency utilized an implicit effectiveness module to measure subjective factors, such as political risk, impact on sustainability, and programmatic. The factors were assigned weights of relative importance based on a survey of senior Army decisionmakers. Subject matter experts then scored how each system fared in light of the implicit criteria.

Third, after determining the values for explicit and implicit effectiveness, the Concepts Analysis Agency used an effectiveness integration model to combine the results of the ratings into a single coefficient of effectiveness for each system. The coefficient of effectiveness provided a relative ranking for the value of each system.

Fourth, the Concepts Analysis Agency performed a detailed analysis of the life-cycle costs of the systems in the analysis. Finally, the coefficient of effectiveness for each system, as well as the results of the cost analysis, were used as input into the optimization model for a cost benefit trade-off analysis. The trade-off analysis determined the subset of systems that provided the maximum effectiveness for three levels of annual funding for research, development, and acquisition. The three levels of funding were \$10.7 billion, \$11.2 billion, and \$11.7 billion.

The Concepts Analysis Agency made a presentation of the results of the Value-Added Analysis to the Army's Council of Colonels and representatives of the Office of the Assistant Secretary of the Army (Research, Development and Acquisition) and the Office of the Army's Deputy Chief of Staff for Operations and Plans.

Near the completion of our audit, the Concepts Analysis Agency initiated another Value-Added Analysis. It was requested for use in reviewing the FYs 1996 through 2001 Program Objective Memorandum.

## **Finding A. Value-Added Analysis**

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In summary, the Army's Concepts Analysis Agency, with the Value-Added Analysis, for the first time provided the Army's Director for Program Analysis and Evaluation and the Army's Deputy Chief of Staff for Operations and Plans with an analytical capability to develop a balanced and effective acquisition program for the Army.

### **Results of the Value-Added Analysis**

At each level of funding, the Value-Added Analysis recommended systems that the Army should buy based on the extent the systems increased force effectiveness over the base force mix. The Value-Added Analysis did not recommend 10 major systems for procurement, including the Comanche Helicopter with the Longbow System, Advanced Field Artillery System, Block III Main Battle Tank, Future Infantry Fighting Vehicle, Future Armored Resupply Vehicle, Main Battle Tank, Line of Sight Antitank Missile, Combat Mobility Vehicle, Air Defense - Anti-Tank System, and the High Mobility Multipurpose Wheeled Vehicle (HMMWV).

The 10 systems were not recommended for procurement at any of the three levels of funding in the analysis. Our review of the analysis disclosed that the systems made only marginal contributions to force effectiveness or were too expensive for procurement at the levels of funding considered in the analysis.

Although the conclusions of the June 1992 Value-Added Analysis showed that the systems should not be procured at any of the three levels of funding, the Army had canceled development of only one system, the Air Defense - Anti-Tank System. It was canceled on January 29, 1992. The value of the nine systems totaled about \$71.4 billion, including \$14.8 billion in research and development funds and \$56.6 billion in procurement funds.

#### **Estimated Program Values**

<b><u>System</u></b>	<b><u>RDT&amp;E</u></b> (billions of dollars)	<b><u>Production</u></b> (billions of dollars)
Comanche Helicopter with Longbow	\$ 6.6	\$32.0
Advanced Field Artillery System	3.2	5.1
Block III Main Battle Tank	1.5	4.2
Future Infantry Fighting Vehicle	1.0	2.0
Future Armored Resupply Vehicle	0.8	4.0
Main Battle Tank	0.6	4.6
Line of Sight Antitank Missile	0.6	3.4
Combat Mobility Vehicle	0.5	1.1
HMMWV	<u>0.0</u>	<u>0.2</u>
<b>Total</b>	<b><u>\$14.8</u></b>	<b><u>\$56.6</u></b>



The Army also deferred development of the Block III Main Battle Tank and the Future Infantry Fighting Vehicle until at least FY 1997. As such, the Army continued to fund seven systems. The Army also returned the Line of Sight Antitank Missile to the technology base and transitioned the Combat Mobility Vehicle to the M1 Abrams derivative breacher. However, the Army did not cancel the systems. As such, the programs for the systems could be restarted.

## **Army's Inaction on the Value-Added Analysis**

The primary reason that the Army did not fully act on the Value-Added Analysis recommendations was because the Army's officials considered the analysis to be one of many tools used to make budget decisions. However, the officials could not provide any other tools showing that the results of the analysis were faulty or conflicted with the results of other studies. To the contrary, the Army's officials who evaluated the analysis were quite complimentary of its results.

## **Effect of Inaction**

Based on the results of the June 1992 Value-Added Analysis, the Army could incur substantial costs for systems that may not add significantly to total force effectiveness at projected funding levels. As shown previously, the nine systems the Army had not acted on involved \$71.4 billion of major acquisition programs.

## **Recommendations, Management Comments, and Audit Response**

**We recommend that the Army Vice Chief of Staff:**

- 1. Utilize the results of the June 1992 Value-Added Analysis to determine the contributions to total force effectiveness and the affordability of the Comanche Helicopter with the Longbow System, Advanced Field Artillery System, Block III Main Battle Tank, Future Infantry Fighting Vehicle, Future Armored Resupply Vehicle, Main Battle Tank, Line of Sight Antitank Missile, Combat Mobility Vehicle, and High Mobility Multipurpose Wheeled Vehicle.**
- 2. Discontinue funding systems that do not contribute significantly to total force effectiveness or are not affordable at projected funding levels.**

## Finding A. Value-Added Analysis

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**Army Comments.** Although the recommendations were directed to the Army's Vice Chief of Staff, he did not provide comments to the draft report. The Acting Assistant Secretary of the Army (Research, Development and Acquisition) provided comments and included a point paper to reinforce the Army's position. The full text of the Acting Assistant Secretary's comments is in Part IV.. The Acting Assistant Secretary nonconcurred with Finding A., stating that the Army used the Value-Added Analysis to gain insights to support prioritization and resource allocation decisions. The Acting Assistant Secretary further stated that the Value-Added Analysis was most valuable when used in "what if funded" types of analyses. However, the Value-Added Analysis neither addressed force structure tradeoffs nor logistics considerations. As such, the results of the Value-Added Analysis should not be taken out of context, such as implying that the Advanced Field Artillery System does not contribute to the effectiveness of the Army. The Acting Assistant Secretary stated that the IG, DoD, based its conclusions on a Value-Added Analysis that was issued in June 1992 and that subsequent analyses performed in December 1992, referred to as the "Investment Programs of the Army Economic and Modernization Analysis (IPAEMA)," with different programmatic assumptions that recommended the Advanced Field Artillery System for procurement.

**Audit Response.** We consider the Army's comments to be nonresponsive to the intent of the recommendations. The Acting Assistant Secretary of the Army (Research, Development and Acquisition) did not address the affordability of the developmental systems that were not recommended for procurement by the Concepts Analysis Agency in the Value Added Analysis of June 1992. We did not intend to give the impression that any of the nine systems did not contribute to the effectiveness of the Army. Each system should provide an increase in effectiveness of the total force when funding is not a consideration. However, at projected funding levels, the Army cannot afford to procure all systems. As such, procurement of certain systems precludes the procurement of other systems, and the Concepts Analysis Agency's recommended procurements maximized total force effectiveness.

As for the Acting Assistant Secretary's comments on analyses performed subsequent to the June 1992 Value-Added Analysis, our review of the subsequent analyses showed that the Advanced Field Artillery System was recommended for procurement in several analyses. However, we determined that the recommendations to procure the Advanced Field Artillery System were based on comparisons of a limited number of systems rather than the more comprehensive Value-Added Analysis performed in June 1992. We also concluded that if the Army procured the Advanced Field Artillery System, the Army still could not afford to procure other systems that were evaluated and determined to make a more significant contribution to total force effectiveness. For example, the procurement of the Advanced Field Artillery System would preclude procurement of the Comanche Helicopter, which would make a more significant contribution to total force effectiveness. As such, we again ask that the Army's Vice Chief of Staff to comment on the recommendations in response to this report. Further, when commenting on the recommendations, we ask the Army's Vice Chief of Staff to consider the overall affordability of the systems presented in this report.

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## **Finding B. Cost and Operational Effectiveness Analysis**

The scope of the Cost and Operational Effectiveness Analysis (COEA) for the AFAS Program was restrictive. The Army's early commitment to a liquid propellant gun precluded considerations of all viable alternatives in preparing the COEA. As a result, the COEA being developed for the AFAS will not provide the Defense Acquisition Board the information necessary to determine whether the proposed AFAS configuration is the most cost and operationally effective solution to deficiencies in the Army's artillery systems.

### **Background**

Two purposes of a COEA are to evaluate the cost of alternative courses of action to meet recognized Defense needs and to determine the operational effectiveness of alternative programs. The DoD Instruction 5000.2, "Defense Acquisition Management Policies and Procedures," Part 4, section E, February 23, 1991, and the DoD 5000.2-M, "Defense Acquisition Management Documentation and Reports," Part 8, discusses the policies and procedures for developing COEAs to support milestone decision reviews. COEAs are required at each milestone. The COEA for the Milestone I program review should focus on the technological concepts and material solutions that could satisfy the Mission Need Statement.

The COEA should include analyses of mission needs, threat, U.S. capabilities, interrelationships of systems, contribution of multi-role systems, measures of effectiveness, and cost-effectiveness comparisons. As part of the analyses, the COEA should reflect the full range of material alternatives for satisfying the deficiency. If all viable alternatives are not in the COEA, decisionmakers cannot determine the most cost and operationally effective alternative. The set of alternatives to be analyzed must consider current systems and improved versions along with systems in development by other Services or allies and conceptual systems. When doubt about whether to analyze an alternative, the alternative should be included. DoD 5000.2-M, Part 8, states that if the alternative is a bad option, the analysis will show that to be the case. If the alternative has merit that was not immediately apparent, the analysis will demonstrate that as well.

Operational effectiveness and cost data must be provided for all alternatives considered. The COEA must also show the sensitivity of each alternative to possible changes in key assumptions or changes in variables, including performance capabilities. Additionally, a COEA must have thresholds that represent the maximum cost or the minimal acceptable performance that can be tolerated in a system before other alternatives become more cost or operationally effective.

## **Finding B. Cost and Operational Effectiveness Analysis**

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The head of the DoD Component that is responsible for the mission area in which a deficiency exists should assign an organization, other than the Project Management Office, the responsibility for preparing the COEA. The Director, Program Analysis and Evaluation, Office of the Comptroller of the Department of Defense, is responsible for assessing the COEA.

### **Consideration of Alternatives**

The Army's COEA Plan for the AFAS provided for the evaluation of four alternatives: the AFAS with a liquid propellant gun, the Paladin, the Paladin Improved, and the German Panzer Howitzer 2000 (PzH 2000). However, our audit identified another alternative that we believe would be beneficial: the Unicharge/Solid Propellant AFAS.

The AFAS Project Management Office did not include the Unicharge/Solid Propellant AFAS alternative in the engineering trade-off analysis and did not plan to include the alternative in the COEA. The Cannon Artillery Propulsion Evaluation Report indicated that a Unicharge-based system could meet the critical requirements for maximum unassisted range, maximum rate of fire, and time on target. Also, the evaluation report showed that a Unicharge-based system could nearly satisfy the requirement for maximum assisted range.

The Unicharge/Solid Propellant AFAS would have several advantages over a liquid propellant AFAS. The Unicharge/Solid Propellant cannon would be similar to existing cannons and would be well understood and easily maintained. Unicharge/Solid Propellant would be compatible with the existing fleet of 155-mm howitzers from the United States and its allies. As such, the Unicharge/Solid Propellant AFAS would preserve interoperability with our forces and our allies' forces, easing the logistical burdens of fielding a new propellant and encouraging future international cooperation in weapons development.

The Army's main argument against the Unicharge/Solid Propellant AFAS is that it is not cost-effective. That argument was based on a study by the Cannon Artillery Propulsion Evaluation Board in 1991 that evaluated a liquid propellant system and the Unicharge propulsion system in areas including cost, development risk, operational effectiveness, and logistics to determine which was more cost-effective. The Board concluded in its report, dated August 20, 1991, that liquid propellant offered better performance than did Unicharge and would have a lower life-cycle cost but entailed greater risk. On September 26, 1991, the Army's General Officer Steering Committee, relying on the conclusions in the study, selected liquid propellant as the propellant of choice for the AFAS. The Committee further directed that Unicharge, a recent solid propellant technology, be developed as an alternative to liquid propellant in case the liquid propulsion technology did not work. The Army Acquisition Executive subsequently ratified the General Officer Steering Committee decision.

## **Finding B. Cost and Operational Effectiveness Analysis**

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Although the study concluded that a liquid propellant system offered better performance than a Unicharge system and would cost less, the report on the study acknowledged that the conclusions were based on immature technical data. Specifically, immature data existed on armament system definition, as well as broad-based characterization of liquid propellant and its manufacturing process. Equally of concern, the study only considered the costs of propulsion systems. It did not show how liquid propellant technology would affect the costs of other subsystems of the artillery system. Thus, it did not analyze the costs of an artillery system with a liquid propellant gun versus an artillery system with a Unicharge-based gun.

### **Reason for Limited Consideration of Alternatives**

The Army's early commitment to a liquid propellant gun precluded fair consideration of other viable alternatives. The Army, with its commitment in 1991 to develop the AFAS with the liquid propellant gun, effectively locked out the Unicharge/Solid Propellant as a viable alternative for the AFAS COEA.

### **Effects of a Limited COEA**

The COEA that the Army was developing for the AFAS will not provide the Defense Acquisition Board with the information needed to determine whether the proposed solution to the deficiency is the most cost and operationally effective. In addition, the COEA will not provide the Defense Acquisition Board with the information needed to reassess the cost-effectiveness of developing a liquid propellant gun at milestone reviews. Such information is essential due to the technical risks associated with the development of the liquid propellant gun. In 1990, the Army Materiel Systems Analysis Agency assessed the risk associated with the AFAS Program and rated the AFAS' requirements for accuracy and rate of fire as medium-high risk areas. Medium-high risk is a rating given to component or subsystem performance deficiencies that will not be corrected before Milestone II. Also, in 1992, the Institute for Defense Analyses reported significant technical problems with the AFAS in materials engineering, interior ballistics, and cooling.

## **Recommendation for Corrective Action**

We recommend that the Director for Assessment and Evaluation in the Office of the Assistant Secretary of the Army (Research, Development and Acquisition) include the Unicharge/Solid Propellant Advanced Field Artillery System as an alternative in the Cost and Operational Effectiveness Analysis for the Advanced Field Artillery System Program.

**Army Comments.** The Acting Assistant Secretary of the Army (Research, Development and Acquisition) nonconcurred with Finding B., stating that the Army had included three alternatives - Paladin, Improved Paladin, and the PzH 2000 - to the AFAS in the COEA and that the three alternatives were appropriate for a Milestone I decision. The Acting Assistant Secretary added that the purpose of a Milestone I review is to determine whether a new acquisition program start is warranted. Further, the AFAS alternative should be viewed as an Operational Requirements Document compliant alternative, regardless of the type of propellant, engine, or armor modeled in the COEA. The Paladin and PzH 2000 howitzers are modeled as Unicharge systems. Also, the use of Unicharge and other improvements for improved range and rates of fire makes the alternatives valid representations of Unicharge weapon systems and meets the intent of the audit recommendations. The Acting Assistant Secretary stated that the Army Acquisition Executive's Decision Memorandum on Liquid Propellant and FY 1994 congressional appropriation language directed the Army to continue development of a Unicharge propellant and cannon as risk mitigation efforts for AFAS. The full text of the Acting Assistant Secretary's comments is in Part IV.

**Audit Response.** We disagree with the Acting Assistant Secretary's position on the recommendation. While we agree that AFAS is a "compliant" alternative, we believe the question remains: is it the best alternative solution? The purpose of the COEA is to consider the full range of alternatives; we believe the Army has not done that yet. DoD Instruction 5000.2 and DoD 5000.2-M state that the COEA should reflect the full range of material alternatives for satisfying the deficiency. If all viable alternatives are not in the COEA, decisionmakers cannot determine the most cost and operationally effective alternative. The set of alternatives to be analyzed must consider current systems and improved versions along with systems in development by other Services or allies and conceptual systems. When doubt about whether to analyze an alternative, the alternative should be included.

The Improved Paladin and the PzH 2000 artillery systems were not representative of a Unicharge-based artillery system. The AFAS Project Management Office determined in the engineering tradeoff studies that the Paladin and Improved Paladin alternatives would not meet the critical requirements. In addition, the AFAS Project Management Office had been unable to obtain the reliable life-cycle cost information necessary for analysis of the PzH 2000 artillery. The Army only included the Paladin and Improved Paladin alternatives in the COEA because the DoD Instruction 5000.2 requires that the existing system and the improved existing system be included.

## **Finding B. Cost and Operational Effectiveness Analysis**

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The Congress' and the Army Acquisition Executive's direction that the Army expend funds to continue development of a Unicharge propellant and cannon as risk mitigation efforts further supports our recommendation that Unicharge/Solid Propellant AFAS alternative should have been in the COEA. Since the Army was developing a Unicharge propellant and cannon, decisionmakers need to know whether the cost of a Unicharge AFAS would exceed the \$3.2 billion that the Army plans to spend on research, development, test, and evaluation for a Liquid Propellant AFAS.

As such, we believe that a Unicharge/Solid Propellant AFAS should be in the COEA. With the change in the threat environment and proposed budget constraints, DoD must examine all means of meeting the requirements. The inclusion of the Unicharge/Solid Propellant would provide the Defense Acquisition Board with a means to measure, for the Milestone I and all future Milestone decisions, whether the proposed AFAS configuration is the most cost and operationally effective solution to deficiencies in the Army's artillery systems. Therefore, we request that the Army reconsider its nonconcurrence with the recommendation.

### **Other Management Comments and Audit Responses to Those Comments**

**Army Comments.** The Acting Assistant Secretary also questioned the conclusion that the Defense Acquisition Board will not have sufficient data to assess the cost-effectiveness of the AFAS at milestone reviews. He explained that the Army performed an extensive analysis of the differences between a Liquid Propellant-based and Unicharge-based AFAS. He claimed that the Liquid Propellant-based system out performed the Unicharge-based system and was more cost-effective from a total life-cycle cost perspective. He also added that on September 16, 1992, the Office of the Secretary of Defense (OSD) approved the Study Plan for the COEA for the AFAS and that there is no new data available that would alter the OSD's approval.

**Audit Response.** After considering the Acting Assistant Secretary's comments, we still believe the conclusion is valid. We were aware of the comparative analysis that the Army made of Liquid Propellant and Unicharge. The Army's Cannon Artillery Propulsion Evaluation Board made the analysis in 1991, as we addressed on page 14. Furthermore, while the analysis may have concluded that liquid propellant was a better choice, the analysis also acknowledged that its resultant conclusions were based on immature technical data, as we discuss on page 15 of this report. Additionally, we question the relevance of the Acting Assistant Secretary's comment about the OSD's approving the Study Plan for the COEA for the AFAS. The COEA that the Army planned for the AFAS did not include a Unicharge/Solid Propellant AFAS alternative. As discussed on page 13 of this report, DoD guidance provides for all alternatives to be included in the COEA.

## **Finding B. Cost and Operational Effectiveness Analysis**

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**Army Comments.** The Acting Assistant Secretary also pointed out that the draft report showed two different amounts (\$1.7 billion and \$3.2 billion) as the amounts that the Army planned to spend on research, development, test, and evaluation for the AFAS. He maintained that the amount should be \$3.0 billion.

**Audit Response.** After reviewing our source data, we revised the \$1.7 billion figure that was in the draft report to \$3.2 billion. The \$3.2 billion was the amount estimated for research, development, test, and evaluation at the time of our audit.



## **Part III - Additional Information**

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## Appendix A. Other Items Warranting Management's Attention

**Performance Requirements.** The performance requirements for the AFAS were not supported by a current Mission Area Analysis. The Army had not updated the Mission Area Analysis for Fire Support to reflect changes in the threat and world situation.

The U.S. Army Field Artillery School last made a complete Mission Area Analysis for Fire Support in January 1981. The analysis was based on a Soviet threat and identified a number of deficiencies in the M109A2/3 artillery systems. As a result of that analysis, the Army initiated a product improvement program, the M109A6 (Paladin). In December 1989, the Army updated the 1981 Mission Area Analysis for Fire Support, but the update was still based on the Soviet threat. The update concluded that major deficiencies still existed in its field artillery system. While the Paladin provided increased survivability, responsiveness, range, reliability, availability, and maintainability, the Paladin did not eliminate the major operational deficiencies.

Since 1989, the geopolitical changes in the world situation and battlefield scenarios have been dramatic. The Soviet Union was dissolved in December 1991 and is now a series of independent states. Also, the DoD is currently emphasizing major regional conflicts as the likely scenarios for future threats.

Although the Mission Area Analysis for Fire Support was outdated, we did not make a recommendation in this report that the Army perform a new Mission Area Analysis. Such an analysis would be labor intensive and costly and would only verify that the deficiencies still exist. Based on discussions with officials at the Army's Training and Doctrine Command and the Army's Foreign Science Technology Center, as well as our analyses of available documentation, including the Army Modernization Plan, Volume II, Annex G, January 1993, we determined that the deficiencies for field artillery in the updated 1989 Mission Area Analysis were still valid. Another reason that we did not make such a recommendation was that the Cost and Operational Effectiveness Analysis (COEA) for the AFAS will determine how well the AFAS and alternative systems compare with the Paladin in meeting battlefield deficiencies in the Army's field artillery systems.

**Quantitative Requirements.** The Army may have overstated the acquisition objective for the AFAS. The acquisition objective provides for the Army to use the AFAS to displace 824 existing howitzers on a one-to-one basis. Based on the increased rate of fire of the AFAS, we concluded that a one-to-one replacement may be excessive. No recommendations are being made on this matter because the Army was aware of the potential overstatement and planned to address it.

**Cooperative Development Opportunities.** The AFAS Project Management Office had not evaluated either the Swedish APS 2000 or the German Panzer

## Appendix A. Other Items Warranting Management's Attention

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Howitzer 2000 for cooperative development opportunities. Both the Swedish and German governments were involved in the development of 155-mm howitzers of greatly increased range, lethality, rate of fire, and mobility. The contractor for the Swedish system expressed interest in the possibility of cooperative development at the system and subsystem levels. At the time of the audit, the AFAS Project Management Office had not commenced the preparation of the Cooperative Opportunities Document for the AFAS. However, the AFAS Project Management Office informed us that it must prepare the Cooperative Opportunities Document for the Milestone I review, which was scheduled for August 1994, and that the document would address our concerns. As such, we made no recommendation in this report.

**Swedish APS 2000 Howitzer.** The AFAS Project Management Office did not perform an engineering trade-off study for the Swedish APS 2000 howitzer to determine the system's viability as a potential system alternative to the AFAS. We determined that Sweden and Norway had a joint venture to produce a 155-mm howitzer of greatly increased range, lethality, rate of fire, and mobility. When we started our review, the AFAS Project Management Office was unaware of the APS 2000 howitzer project. The APS 2000 howitzer was in a study and development phase. Goals for the system meet the AFAS operational requirements of range, rate of fire, and survivability. The Swedish Defense Department indicated that it fully supported the APS 2000 howitzer project.

Although the Army had not considered the APS 2000 howitzer as an alternative to the AFAS, the Director for Assessment and Evaluation in the Office of the Assistant Secretary of the Army (Research, Development and Acquisition) agreed that the Army would evaluate the capabilities of the APS 2000 howitzer. Further, he agreed that the Army would determine whether the APS 2000 howitzer offered capabilities superior to the German PzH 2000 howitzer, which the Army said was the best foreign alternative to the AFAS of 10 foreign systems that the Army considered. As such, we are making no recommendation in this report to include the APS 2000 howitzer in the COEA as an alternative to the AFAS.

**Budget Estimates.** The AFAS Project Management Office had a \$32 million funding shortfall due to reductions in its FY 1994 budget. The Project Management Office had funded approximately \$20 million of the shortfall through reprioritization of planned developmental efforts. The AFAS Project Management Office was aggressively searching for other funding alternatives. We made no recommendation on the matter because no developmental requirements had been deferred that would preclude the Milestone I decision or the Demonstration/Validation solicitation and management was aggressively working the issue.

**Acquisition Strategy.** Extensive developmental contracting in Milestone 0 may severely limit the AFAS Project Management Office's ability to compete future contracts. Generally during Milestone 0, project management and program offices limit their efforts to studies to determine the best concept for meeting deficiencies in existing systems. However, direction by the Congress, the DoD, and the Army, elevating the AFAS to the lead system of the Armored System

## Appendix A. Other Items Warranting Management's Attention

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Modernization - Future Program, contributed to substantial contractual investments for major components of the AFAS, including investments for the chassis, engine, and liquid propellant gun. The contractual award for demonstration and validation will focus on further development and integration of the mobility, firepower, and survivability features. As such, it appears problematic whether new contractors could compete with the contractors who have been involved with the developmental contracts. On the other hand, we question whether it would be economical now to change the direction of developmental efforts. As such, we decided not to make any recommendation on this matter.

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## **Appendix B. Audit Conclusions on Other Matters**

We did not identify significant problems during our review of the program management elements of Scheduling and Contracting. We determined that it was too early in the life of the AFAS Program to evaluate the program management elements of Cost Estimating and Analysis and Test Planning.

**Scheduling.** We determined that the AFAS Project Management Office has an active program to manage and mitigate technical risk. The program included research and development work being done on contract and in-house by supporting the DoD laboratories.

**Contracting.** We determined that the Army Audit Agency's review of the contracting function for the AFAS Program was sufficient to satisfy our stated audit objectives regarding contracting practices. Therefore, we performed only limited audit work in this area. We found no conditions warranting management's attention.

**Cost Estimating and Analysis.** We determined that it was too early to perform extensive audit work in this area because the cost and operational effectiveness analysis, baseline cost estimate, and life-cycle cost estimate are not scheduled to be completed until late FY 1994.

**Test Planning.** We did not identify test planning deficiencies. The Test and Evaluation Master Plan was adequate for a program in phase 0 and it was too early in the program for detailed test plans of system-level test events.

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## **Appendix C. Summary of Potential Benefits Resulting From Audit**

<b>Recommendation Reference</b>	<b>Description of Benefit</b>	<b>Amount and/or Type of Benefit</b>
A.1. and A.2.	Economy and Efficiency. Will ensure that the Army is acquiring the most affordable force effectiveness mix of weapon systems.	Undeterminable monetary benefit until management decides whether research and development should be discontinued on certain systems.
B.	Program Results. Will provide the data needed to determine the cost and operational effectiveness of the Advanced Field Artillery System.	Nonmonetary.

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## **Appendix D. Organizations Visited or Contacted**

### **Office of the Secretary of Defense**

Office of the Under Secretary of Defense for Acquisition and Technology, Washington, DC

Office of the Director, Program Analysis and Evaluation, Washington, DC

### **Office of the Joint Chiefs of Staff**

Director for Force Structure, Resources and Assessment, Washington, DC

Director for Operational Plans and Interoperability, Washington, DC

### **Department of the Army**

Office of the Chief of Staff, Washington, DC

Office of the Assistant Secretary of the Army (Research, Development and Acquisition), Washington, DC

Office of the Deputy Chief of Staff for Intelligence, Washington, DC

Office of the Deputy Chief of Staff for Operations and Plans, Washington, DC

Headquarters, Training and Doctrine Command, Fort Monroe, VA

Office of the Studies Division, Fort Sill, OK

Office of the Systems Integration and Priorities Division, Fort Sill, OK

Office of the Training and Doctrine Command Systems Manager for Cannons, Fort Sill, OK

Study and Analysis Center, Fort Leavenworth, KS

Army Audit Agency, Picatinny Arsenal, NJ

Army Concepts Analysis Agency, Bethesda, MD

Army Materiel System Analysis Agency, Aberdeen, MD

Army Cost and Economic Analysis Center, Falls Church, VA

Army Foreign Science Technology Center, Charlottesville, VA

Office of the Program Executive Officer for Armaments, Picatinny Arsenal, NJ

Office of the Program Executive Officer for Armored Systems Modernization, Warren, MI

Office of the Project Manager for the Advanced Field Artillery System, Picatinny Arsenal, NJ

Office of the Project Manager for the Future Armored Resupply Vehicle, Picatinny Arsenal, NJ

White Sands Missile Range, White Sands, NM

## **Appendix D. Organizations Visited or Contacted**

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### **Defense Agency**

Defense Systems Management College, Fort Belvoir, VA

### **Non-Defense Organizations**

Bofors Defense Systems, Alexandria, VA  
Embassy of Germany, Washington, DC  
Embassy of Sweden, Washington, DC  
Institute for Defense Analyses, Alexandria, VA  
Liaison Office of Germany, Picatinny Arsenal, NJ



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## **Appendix E. Report Distribution**

### **Office of the Secretary of Defense**

Under Secretary of Defense for Acquisition and Technology  
Comptroller of the Department of Defense  
Director, Program Analysis and Evaluation  
Assistant to the Secretary of Defense for Public Affairs

### **Department of the Army**

Secretary of the Army  
Chief of Staff  
Assistant Secretary of the Army (Research, Development and Acquisition)  
Auditor General  
Program Executive Officer for Armored Systems Modernization  
Program Executive Officer for Field Artillery Systems  
Director, U.S. Army Concepts Analysis Agency  
Commander, Combined Arms Command and Fort Leavenworth  
Project Manager for the Advanced Field Artillery System

### **Department of the Navy**

Auditor General, Naval Audit Service

### **Department of the Air Force**

Auditor General, Air Force Audit Agency

### **Defense Organizations**

Director, Defense Contract Audit Agency  
Director, Defense Logistics Agency  
Inspector General, Defense Intelligence Agency  
Inspector General, National Security Agency  
Director, Defense Logistics Studies Information Exchange

### **Non-Defense Federal Organizations**

Office of Management and Budget

## **Appendix E. Report Distribution**

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**U.S. General Accounting Office, National Security and International Affairs Division,  
Technical Information Center**

**Chairman and Ranking Minority Member of Each of the Following Congressional  
Committees and Subcommittees:**

**Senate Committee on Appropriations  
Senate Subcommittee on Defense, Committee on Appropriations  
Senate Committee on Armed Services  
Senate Committee on Governmental Affairs  
House Committee on Appropriations  
House Subcommittee on Defense, Committee on Appropriations  
House Committee on Armed Services  
House Committee on Government Operations  
House Subcommittee on Legislation and National Security, Committee on  
Government Operations**

## **Part IV - Management Comments**

# Department of the Army Comments



DEPARTMENT OF THE ARMY  
OFFICE OF THE ASSISTANT SECRETARY  
RESEARCH DEVELOPMENT ACQUISITION  
103 ARMY PENTAGON  
WASHINGTON, DC 20310-0103



04 APR 1994

SARD-SC

## MEMORANDUM FOR INSPECTOR GENERAL, DEPARTMENT OF DEFENSE

SUBJECT: Draft Audit Report on the Acquisition of the Advanced Field  
Artillery System (Project No 3AL-0025)

The Office of the Assistant Secretary of the Army (Research, Development and Acquisition) has reviewed subject draft audit report and provides the following comments. To reinforce the Army's position on subject draft audit report, a Point Paper is also enclosed.

a. This office nonconcurs with Finding A, "Value-Added Analysis "

"The Army continued to develop the Advanced Field Artillery System (AFAS) and other systems costing \$71.4 billion, despite an interactive analysis of multiple systems that questioned the systems' contributions to total force effectiveness and affordability at projected funding levels. The Army did not act on the Value-Added Analysis because its officials considered the analysis to be only one of many tools that they used to make budget decisions. As a result, the Army could incur substantial costs for systems that may not be affordable at projected funding levels."

The Value-Added Analysis (VAA) is a methodology used by the Army to gain insights to support prioritization and resource allocation decisions. It is most valuable as an analytic tool when used to address "what if funded" types of sensitivity excursions. VAA does not address force structure tradeoffs nor represent logistics, which are two major potential advantages of AFAS. VAA results should not be taken out of context. Analysis results for FY94-99 Program Objective Memorandum indicate that AFAS, when linked to the Future Resupply Vehicle (FARV), ranks in the top three of all systems considered for its value added to combat force effectiveness. Although an earlier case (referred to in the audit report) did not recommend AFAS for funding under prescribed programmatic limitations, several sensitivity excursions with different programmatic assumptions supported AFAS procurement.

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b This office nonconcurs with Finding B, "Cost and Operational Effectiveness Analysis "

"The scope of the Cost and Operational Effectiveness Analysis (COEA) for the AFAS Program was restricted. The Army's early commitment to liquid propellant gun precluded considerations of all viable alternatives in preparing the COEA. As a result, the COEA being developed for the AFAS will not provide the Defense Acquisition Board with the information necessary to determine whether the proposed AFAS configuration is the most cost and operationally effective solution to deficiencies in the Army's artillery systems "

The Army's alternative cannon systems for the COEA (Paladin, Improved Paladin, the German Panzer Howitzer 2000 (PzH2000) and AFAS) are appropriate for a Milestone I COEA. The purpose of a Milestone I Review is to determine if a new acquisition program start is warranted. In this context, the AFAS alternative should be viewed as an Operational Requirements Document (ORD) compliant alternative, regardless of the type of propellant, engine, armor, etc., modeled in the COEA. The Improved Paladin and the PzH2000 are modeled as Unicharge systems. The use of Unicharge and other improvements for improved range and rates of fire makes them valid representation for Unicharge weapon systems and meets the intent of your recommendations. As directed by the Army Acquisition Executive Decision Memorandum on Liquid Propellant and FY94 Congressional appropriation language, the Army is continuing to develop the XM-230 Unicharge propellant and 52 caliber XM-297 Cannon as risk mitigation efforts for AFAS.

In Appendix A of the Audit Report, the DoDIG identifies the Swedish Artillery Piece System (APS) 2000 Howitzer, a technology demonstration, as a potential alternative. While this system conceptually meets the ORD performance requirements, it is much too early in its development to be included as a separate alternative. Its capabilities are represented by the Improved Paladin and the PzH2000.

Based on the above facts that serve to highlight the deficiencies in the DoDIG draft audit Findings A and B, it is recommended that these findings be modified to include the assumptions and limitations from which they were derived. We encourage the DoDIG to consider the "IPAEMA" VAA study and alternative Unicharge-based systems results in their review.

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This office will continue to support DoDIG's audit efforts in any way possible. The point of contact as audit liaison is Christopher Newborn at DSN 225-0787.



George E. Dausman  
Acting Assistant Secretary of the Army  
(Research, Development and Acquisition)

Enclosure

CF  
SARD-DO  
DAMO-FDG  
PEO-FAS  
Army Audit Agency

SARD-SC  
23 March 1994

POINT PAPER

SUBJECT: Draft Audit Report on the Acquisition of the  
Advanced Field Artillery System (Project No.  
3AL-0025)

The Office of the Assistant Secretary of the Army,  
Research, Development and Acquisition has reviewed the  
subject draft audit report and provides additional comments:

Audit Report Finding A: "The Army continued to develop the Advanced Field Artillery System (AFAS) and other major systems, which were estimated to cost \$71.4 billion, despite an interactive analysis of multiple systems that questioned the systems' contributions to total force effectiveness and affordability at projected funding levels. The Army did not act on the Value-Added Analysis because its officials considered the analysis to be only one of many tools that they used to make budget decisions. As a result, the Army could incur substantial costs for systems that may not add significantly to total force effectiveness and may not be affordable at projected funding levels."

DoDIG Audit Statement: Advanced Field Artillery System (AFAS) does not contribute significantly to the combat effectiveness of the future force to warrant further programmed funding.

Army Response: The Value Added Analysis for POM FY94-99 indicates that the AFAS, when linked with the Future Armored Resupply Vehicle (FARV), ranks in the top three of all systems considered for its value added to combat effectiveness, exceeded only by the Future Infantry Fighting Vehicle and the Comanche helicopter armed with Longbow. The VAA results indicated the AFAS-FARV system is a valuable combat multiplier that contributes significantly to the combat effectiveness of the future force. Therefore, it is within the interest of the Army to pursue its development.

The Army has conducted a number of iterations (each a QRA) designed to determine what programmatic trade-offs recommend a system for procurement. The QRA conducted under the acronym "IPAEMA" recommended the AFAS-FARV for procurement under a specific set of programmatic assumptions and circumstances (in seven excursions, AFAS was recommended 4 of 5 times and forced out of consideration twice a priori).

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**DoDIG Audit Statement:** Even though the VAA recommended that 10 systems not be procured, only one system has been canceled.

**Army Response:** Funds have not been applied to any of the systems that were either deferred or canceled. Furthermore, these systems cannot be restarted without the approval of the Defense Acquisition Board or other decision authority.

**DoDIG Audit Statement:** The reason why the Army did not fully act on VAA recommendations was because Army officials considered the analysis to be one of many tools used to make budget decisions. Also, the Army could not provide any other tools showing that the VAA were faulty or conflicted with other studies.

**Army Response:** This is not accurate since an additional VAA, completed in Dec 92, which recommended AFAS for procurement, was provided to DoDIG on 21 Dec 93. Additionally the Cost and Operational Effectiveness Analysis (COEA) is a tool used for providing the analytical under-pinning or rationale for decisions on a program. The VAA did not take this approach to arrive at its conclusion.

**DoDIG Audit Report Finding B:** "The scope of the Cost and Operational Effectiveness Analysis (COEA) for the AFAS Program was restricted. The Army's early commitment to a liquid propellant gun precluded considerations of all viable alternatives in preparing the COEA. As a result, the COEA being developed for the AFAS will not provide the Acquisition Defense Board the information necessary to determine whether the proposed AFAS configuration is the most cost and operational effective solution to deficiencies in the Army's artillery systems".

**DoDIG Audit Statement:** The Defense Acquisition Board will not have sufficient data to assess the cost effectiveness of the Liquid Propellant Gun at the Milestone Reviews.

**Army Response:** The analysis performed in selecting AFAS' propellant was very extensive. The analysis addressed the differences between a Liquid Propellant-based and a Unicharge-based AFAS system (e.g., armament and automated ammunition handling). The results showed that the Liquid Propellant-based system outperformed the Unicharge-based system and was more cost effective from a total life-cycle cost perspective. On 16 Sep 92, OSD approved the AFAS/FARV COEA Study Plan and there is no new data available which would alter that decision today.



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**DoDIG Audit Statement:** Omission of a Unicharge-based AFAS system in the COEA was exacerbated by the high technical risks of the Regenerative Liquid Propellant Gun development.

**Army Response:** This statement seems to be based on a risk assessment performed by the Army Materiel System Analysis Activity in 1990 which assessed AFAS accuracy and rate of fire as medium high risk and the Institute for Defense Analysis report that identified technical problems with AFAS in material engineering, interior ballistics and cooling. The Program Manager for AFAS discussed with the DoDIG survey team ongoing risk mitigation efforts that centered around critical technologies and development, as well as the management process and program techniques used to execute, monitor and adjust the direction of the focus (i.e. technical performance measures, schedule networks, work packages, quarterly reviews, cost management reviews). The Army Acquisition Executive Decision Memorandum and FY94 Congressional Appropriation Language has directed the continued development of the XM230 unicharge propellant and 52 caliber XM297 cannon as a back-up to AFAS. If LP development becomes too high of a risk during the Acquisition Phase I or II, then an Unicharge-based AFAS will become the leading alternative in the COEA.

**DoDIG Audit Statement:** Although a liquid propellant system offered better performance and would cost less than a Unicharge-based system, the Army's conclusion and decision was based on immature technical data.

**Army Response:** In the Army's opinion, sufficient data is available to support this rigorous estimating process for the AFAS and it's associated armament.

**DoDIG Audit Statement:** The Army's commitment in 1991 to develop the AFAS with the liquid propellant gun effectively locked out the unicharge/solid propellant as a viable alternative for the AFAS COEA.

**Army Response:** As part of the Engineering Tradeoff Analysis prior to the start of the COEA, the AFAS Project Manager evaluated an extensive list of 10 candidates which included several systems which employed unicharge/solid propellant (for examples, Paladin (I), German PzH 2000, Israeli Slammer, French AUF-1, and British AS-90). Of that original list, the Senior Advisory Group directed that four candidates be included in AFAS/FARV's COEA (Paladin, Paladin

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Reference

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(I), PzH 2000, and AFAS), of which PzH 2000 and Paladin (I) employed unicharge. The use of unicharge and other improvements for improved range and rate of fire makes them valid representation for unicharge weapon systems and meets the intent of the Inspector General's recommendation.

**DoDIG Audit Statement:** DoD 5000.2 requires that the services review foreign conceptual systems as well.

**Army Response:** The system in question is the Swedish APSs 2000. This system, at the time of the audit, was in what would be comparable to our Concept Exploration and Development Phase. The APS 2000 survivability, mobility, sustainability, and the command, control and communications systems were of significantly less capability than our own conceptual AFAS. These shortcomings were reported 14 Jul 93 to the DoDIG office. If the APS 2000 had been carried forth into a formal material developers engineering trade-off analysis, it would have soon been dropped as an alternative based on performance.

**DoDIG Audit Statement:** The Army had not updated the Mission Area Analysis for Fire Support to reflect changes in the threat and world situation.

**Army Response:** The Army Training Analysis and Doctrine Command no longer does Mission Area Analysis. This type of analysis is done in the COEA, Mission Need Statement and Operational Requirements Document.

**Army General Comments:** The draft audit report is conflicting as to the value of the RDTE efforts for AFAS. Page two, under background, states that "the Army plans to spend \$1.7 billion of research, development, test and evaluation funds on the AFAS", and page 11 in Finding A shows the estimated program value for AFAS RDTE as \$3.2 billion. Though, determining the current RDTE profile is difficult at this time because the Army Cost Position is in process in preparation for Milestone I, the Army currently has programmed about \$3.0 billion for the Demonstration and Validation Phase and Engineering, Manufacturing and Development Phase for AFAS.

Mr. Newborn/50787

Revised  
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